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# SCHISTOSOMIASIS DETECTION AMONG SCHOOL AGED CHILDREN IN COMMUNITIES LIVING ALONG THE NYAMA RIVER SYSTEM IN ENUGU STATE NIGERIA

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**AUTHORS' CONTRIBUTIONS**

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## ABSTRACT

Schistosomiasis is a public health concern particularly in rural areas where poverty and poor social amenities prevail. The disease infect**s** mostly children of school age and pregnant women, more often those living close to water bodies harbouring the snail intermediate host of the causative agent of schistosomiasis. The Nyama River system transverses many communities in Enugu State and the prevalence of schistosomiasis in these communities is unknown. This study therefore aimed to determine the prevalence of schistosomiasis infection among school-aged children living along the Nyama River system. A cross- sectional study involving urine and stool microscopy was used to demonstrate eggs of parasites respectively. The result showed an overall prevalence of 21.7% for *Schistosoma haematobuim* and 17.6% for *Schistosoma mansoni* infections; more males were infected with *Schistosoma haematobuim* (27.9%) than females (15.1%). There was a statistically significant difference between infections among age groups ($P < 0.05$) with children between 9 – 11 years having more infection than the other age groups. There was also statistically significant difference in infection among schools with Akwuke Primary school having the highest rate of infection in comparison to the other schools. It is recommended that the government develop control strategies for afflicted school children. Also, large-scale testing and treatments should be carried out for the entire community, including all age groups, to determine the transmission cycle from adults to children.

**Keywords:** Host; schistosomiasis; transmission; prevalence; Nyama River; Enugu.

## 1. INTRODUCTION

Schistosomiasis, often known as snail fever or bilharziasis, is a chronic infectious disease transmitted by parasitic flatworms (trematodes) of the genus *Schistosoma* [1]. *Schistosoma haematobuim*, *Schistosoma japanicum* and *Schistosoma mansoni* are the parasites that cause the majority of human illnesses. *Schistosoma haematobuim* causes urinary schistosomiasis, while *Schistosoma japanicum* and *Schistosoma mansoni* cause intestinal schistosomiasis [2,3].

Schistosomiasis is one of the most prevalent Neglected Tropical Diseases (NTDs) but remains a major public health concern in Africa, Asia, and South America [4]. Schistosomiasis has been reported in 78 countries globally, with the disease endemic in

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52 of these countries [5]. Schistosomiasis-endemic areas are home to over 750 million people, with over 200 million people affected worldwide and 91% of them are in Africa [5]. In Sub Saharan African, Nigeria has the highest schistosomiasis infection with over 29 million people infected. Ethiopia [6] and Kenya [7] have estimates of over 5 million and 6 million infected people respectively, with 37 million and 15 million people at risk of infection. Approximately 206.4 million Schistosoma infected people require treatment [5]. The annual global schistosomiasis related mortality range from 24,067 to 200,000 [8]. Schistosomiasis is poverty-related, particularly widespread in areas with limited access to safe drinking water and poor environmental hygiene [9]. This disease has a high mortality and morbidity rate among school-aged children, adolescents, and young adults [10]. Schistosomiasis patients can remain infected for a prolonged period due to the chronic disease's vulnerability to re-infection [11]. Sugarcane and rice farming areas, as well as fishing areas, are typically endemic for schistosomiasis, and people can become infected while swimming or bathing in waters contaminated with Schistosoma parasites shed by snails. The parasite penetrates the human skin to infect humans [12]. In Africa, two of the Schistosoma species that infect humans (*Schistosoma mansoni* and *S. haematobuim*) have been identified as the most prevalent species [5]. The two species are responsible for urogenital and intestinal schistosomiasis respectively. Urogenital schistosomiasis causes major health problems and morbidities, particularly in women and children [5, 13]. Pregnancy concerns include anaemia, placental issues that result in low birth weight kids, an increased risk of contracting the Human Immunodeficiency Virus (HIV), kidney and bladder fibrosis, cancer of the bladder, vaginal bleeding, and genital lesions [5]. Children, on the other hand, experience malnutrition, anaemia, poor growth, and decreased mental and cognitive development, all of which have a negative effect on overall productivity and development [14].

Schistosomiasis continues to have a severe impact in Nigeria, affecting the general well-being of school-aged children and potentially leading to dysuria, haematuria, hydronephrosis, bladder wall pathology, and squamous cell carcinoma. The Nyama River system transverse through many communities in Enugu State and the prevalence of schistosomiasis in these communities is unknown. This study therefore aimed to determine the prevalence and species of Schistosoma infection among school-aged children living along the Nyama River system.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was conducted in the communities living along the Nyama River system link including Akwuke, Atakwu, Umuagba and Umuogo Amechi Uno/Obeagu communities in Enugu South Enugu is the state capital of Enugu State in Nigeria. Enugu State is located on the Greenwich Meridian between latitudes 5°56'N and 7°36'N and longitudes 6°53'E and 7°55'E [15]. The state has a geographic approximate area of 8,022.95 km2 and a population of 3,267,837 people [16]. The Nyama River serves the communities mentioned above as a water source for domestic activities, such as washing of clothes, irrigation of riverbank vegetable farms. In addition, certain portions of the river are used for beach parties and local tourism. Holidaymakers and schoolchildren relish swimming in the rivers, especially during hot weather.

### 2.2 Study Population

The study's target population was school children aged 6 to 14 years. The age range was selected because it is a high-risk age bracket [17]. It is also the age bracket with the highest documented severity and prevalence of schistosomiasis [18].

### 2.3 Inclusion and Exclusion Criteria

All school-aged pupils in the selected primary schools who had been enrolled for over a year were eligible to participate in this study. Pupils in primary one were excluded from the trial because the majority fell out of the age range of the target population.

### 2.4 Sample Collection

Pupils were educated on how to collect the mid-stream of their urine. Thereafter, they were given clean-labeled containers to collect the urine after exercising for about 2 hours. The pupils were also given another bottle for the collection of faecal samples. Collected samples were immediately put in cooling boxes with ice and transferred to the ESUT teaching hospital laboratory for analysis.

### 2.5 Parasitological Examination

The faecal samples were promptly examined physically for consistency, colour, and the presence of blood. Smears of stool samples were prepared for wet mount and examined microscopically for *Schistosoma* eggs using x10. For the urine, the Nuclepore urine

filtration technique as described by Richards et al. [19] was used to detect *Schistosoma* eggs. This approach entailed passing urine (10 ml) through a microfilm with a pore size of 15 m. The filtrates were examined for *Schistosoma* eggs.

## 2.6 Data Analysis

All data collected were analyzed using the Statistical Package for Social Sciences (SPSS) version 23.0. Proportion of infection was expressed in per cent, while infection between age groups; sexes were compared using Analysis of variance. In all the analyses the ascribed threshold significance level was set at P=0.05.

## 3. RESULTS

Pupils aged 9–11 years had the highest infection of *Schistosoma* (23.5%) followed by pupils aged 6 – 8 years, who had 23.9%, while 12–14 years group had the least infection rate of 18.3% (Table 1). *Schistosoma haematobuim* and *S. mansoni* infections in the studied population were 21.7% and 17.6% respectively. Male pupils had (27.9%) of *S. haematobuim* and 21.4% of *S. mansoni* representing highest infection prevalence for both species. Female pupils recorded 15.1% *S. haematobuim* and 13.7 % of *S. mansoni* infection (Table 1). Comparatively there was significant difference in proportion of infection between 9-11 years and 12-14 years (F=2.715;P=0.007).

The prevalence of S*chistosoma* infection in the different schools in relation to distance from Nyama River is shown in Table 2. Central Primary School, Akwuke, which was less than 500 meters from the river, had the highest proportion of infection (42.2%), followed by Central Primary School, Akegbe (39.2%). Central school, Amagu was the farthest from Nyama River and recorded the lowest infection rate (11.4%). There was statistically significant difference in proportion of infection between schools except for Community Primary School, Obeagu and Army Children's School, Garriki (F= 2.364; P = 0.053) even though Obeagu had more infection (Table 2).

### 3.1 Intensity of *Schistosoma haematobuim* Infection in Pupils According to Primary Schools Studied

The intensity of *Schistosoma haematobium* infection was measured by eggs shed in the urine samples from the pupils examined and is presented in Fig. 1. A total number of 1346 eggs per 20 ml of urine was recorded from the pupils at Central Primary School, Akwuke, whereas Central Primary School, Akegbe, Community Primary School, Obeagu, Army Children's School, Garriki, and Central school, Amagu recorded 1003, 656, 499, and 452 total *Schistosoma haematobuim* eggs, respectively.

**Table 1. *Schistosoma haematobuim* and *S. mansoni* infection rates in three age groups**

| Age range | Number of Pupils Sampled | | | Number of pupils positive with *S. haematobuim* | | | Positive with *S. mansoni* | | | Total | Prevalence (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total | Male | Female | Total | | |
| 6 – 8 | 40 | 36 | 76 | 11 | 5 | 16 | 11 | 4 | 15 | 31 | **40.8** |
| 9 – 11 | 81 | 72 | 153 | 25 | 11 | 36 | 20 | 14 | 34 | 70 | **45.6** |
| 12 – 14 | 33 | 38 | 71 | 7 | 6 | 13 | 2 | 2 | 4 | 17 | **23.9** |
| Total | 154 | 146 | 300 | 43 | 22 | 65 | 33 | 20 | 53 | 152 | **50.7** |
| Over all | | | | **27.9** | **15.1** | **21.7** | **21.4** | **13.7** | **17.6** | **50.7** | |

**Table 2. The prevalence of *Schistosoma haematobuim* infection in the five schools studied in relation to river location**

| Distance to Nyama River | School | No. of Pupils | Positive | Negative | Infection rate (%) |
|---|---|---|---|---|---|
| 500 – 700 Meters | Central Primary School, Akwuke | 70 | 26 | 44 | $37.1^{a}$ |
| | Central Primary School, Akegbe | 56 | 19 | 37 | $33.9^{a}$ |
| 3 – 4 Kilometers | Community Primary School, Obeagu | 55 | 8 | 47 | $14.5^{b}$ |
| | Army Children's School, Garriki | 58 | 7 | 51 | $12.1^{b}$ |
| ≥ 7 kilometers | Central school, Amagu | 61 | 5 | 56 | $8.1^{b}$ |
| Total | | **300** | **65** | **235** | **21.7%** |

*The values with different letters in superscript show that there are significant differences in the rates of infection between schools (F=2.364, P=0.053)*

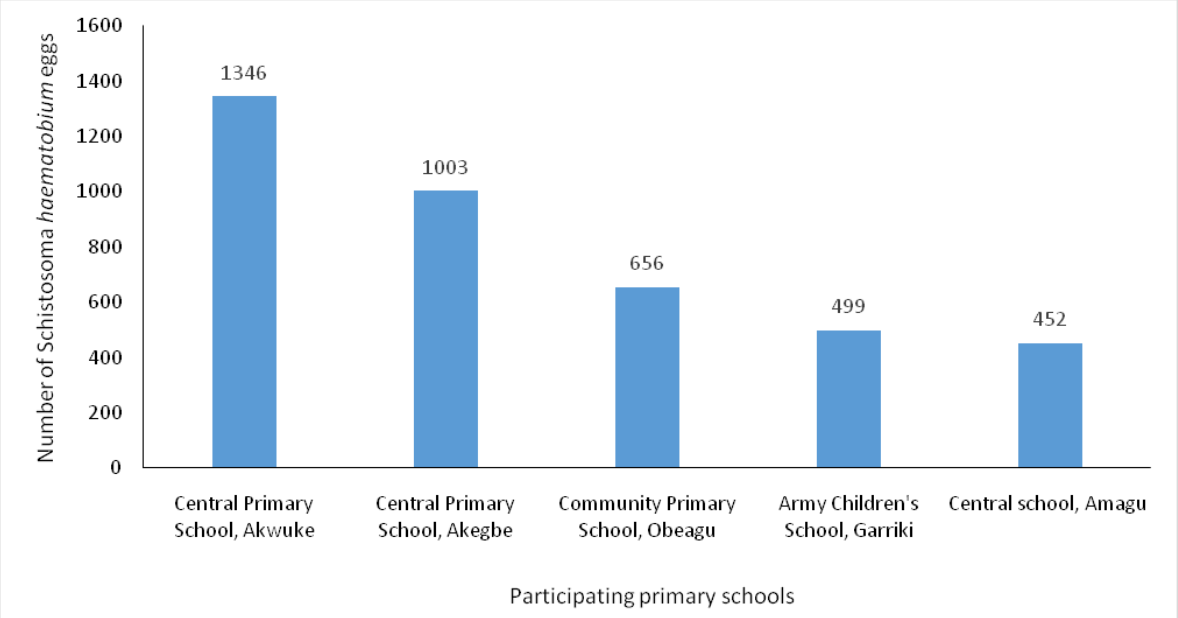


**Fig. 1. Total number of *S. haematobuim* eggs collected from the primary schools sampled**

## 4. DISCUSSION

The prevalence of schistosomiasis in primary school children living along Nyama River was studied and the result was revealing. *Schistosoma haematobuim* and *S. mansoni* were the two species observed and prevalent among the studied school children. The over all prevalence (50.7%) was high when compared with the findings of previous studies. It exceeds the national prevalence of about 9.5% [20], and is also greater than the 17.5% prevalence found in Kano State rural areas [21] and the 20% prevalence observed among pregnant women in rural communities in Nigeria [22]. This can be attributed to a number of factors, including Nyama River, which serves as a source of water for both drinking and domestic uses as well as for fishing and swimming. Swimming and other activities provide an opportunity for infected hosts to seed Schistosoma eggs into the River, therefore enhancing transmission to other users of the river. Schistosomiasis is the most common and is endemic in many communities where there are rivers and streams that last more than a year and serve as a source of social and economic activities like swimming, fishing, commercial sand excavation, irrigation, domestic washing etc. [23]. *Biomphalaria pfeifferi* and *Biomphalaria glabrata* snails can be infected with *S. mansoni*, *Planorbarius metidjensis* is responsible for *Schistosoma bovis* transmission, and *Bulinus truncatus* snails are the natural hosts for *S. bovis* and *S. haematobium*. The presence of appropriate snail species that serve as intermediate hosts to *Schistosoma* [24,25] and frequenting of both infected and non-infected populations to these streams and rivers has sustained the endemicity. A lack of public awareness and lack of programs on health education, inadequate distribution of praziquantel to infected individuals in government hospitals [26], and a lack of modern water sources such as bore holes and tap water, which limit human water contact rates [27].

The recent study also finds that distribution of schistosomiasis infection among males (827.9%) was significantly higher ($P<0.05$) than that of females (15.1%). Our finding was in agreement with previous studies [28]. Culturally, the males are at liberty to move around, fetch water, hunt, fish and swim unlike the females who are culturally restricted to kitchen/domestic work at home and sometimes fetching of water. Similar trend were discovered in studies in Kenya [29] and Tanzania [30]. The disparity between male and female pupils could be because the male pupils spend a lot of time playing in *schistosoma*-infested Nyama Rivers. Additionally, male pupils usually assist their parents in the farm, canoe padding, and fishing in rivers infested with schistosome [31].

These behavioral activities are epidemiologically important in the transmission of schistosomiasis [24,32,33] and might be responsible for the higher prevalence observed amongst the males.

In this study, primary school pupils aged 9 to 11 had the highest infection (23.5%) while pupils aged 6 to 8 had 21.1 % and pupils aged 12 to 14 had low infection of 18.3%. The findings are more consistent with the generally observed trend, which shows a peak in age 9

and a progressive drop in infection with an increase in age [26]. The risk of schistosoma infection was least in the age category 12 to 14 years (16.4 %), this is consistent with the study by Matonge et al. [34], where they attributed the reduced rate of infection to the practice of good hygiene in this group and an increase in the number of pupils who constantly wear shoes in this group.

Among the schools surveyed, pupils from schools within 500 – 700 meters from Nyama River had higher rates of infection. Pupils from Central Primary School, Akwuke had the highest schistosomiasis incidence levels at 42.9%, followed by pupils from Central Primary School, Akegbe with 39.2%, and pupils from Community Primary School, Obeagu with 17.8%. This indicates that the areas with significant transmission rates are places where there are unregulated water contact activities and places where multiple open water bodies are extensively available for household and recreational usage [35]. In Army Children's School, Garriki and Central school, Amagu, the incidence rates were 13.8% and 11.4%, respectively. This finding could be due to limited access to Nyama River by the pupils in these schools, because of the long distance, which is around 4 - 7 kilometres from these schools [36,37].

## 5. CONCLUSION

The present study reveals that *S. haematobuim* infection is prevalent in the communities surrounding the Nyama River. *Schistosoma haematobuim* infection is sometimes sex related because of the different activities engaged by the different genders, expose the male pupils more to *Schistosoma* infection.

The age range of 9–11 years had a considerably higher infection rate of 23.5%, while the age group 12–14 years had the lowest infection rate of 18.3%. We concluded that *Schistosoma* infection peaks among children between 9 – 11 year and then reduces with a further increase in age.

Infection rates in schools reduced as distance from the Nyama River increased, as shown in Central Primary School, Akwuke, which is 500M from the Nyama River with the highest infection rate and Central school, Amagu, which is the farthest (7KM) school from Nyama River among the school studied showed the least infection rate.

## CONSENT AND ETHICAL APPROVAL

Enugu State University of Science and Technology (ESUT) Teaching Hospital Parklane granted permission to do the research. Each headmaster of the selected primary schools approved and consented to the research with their pupils. Participation was optional, and pupils and their guardians were informed and had the right to withdraw at any time from the research without consequence. Additionally, the parents of the children involved provided written approval prior to their participation in the study.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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